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Agricultural Memorandum No. 935

By M N Hough

Results of Sheltering a Spring Barley Crop at Boulby, Cleveland

Agricultural Memorandum No. 901 described the arable area of coastal Cleveland and the problems associated with wind and salt damage to crops grown in the area. In 1981 advantage was taken of a spring barley trial on a farm in the area to test if there would be a response to sheltering the crop.

The Trial Site

Spring barley was sown in a plot trial (cv's Atem and Goldmarker) in a field on top of the cliffs near Boulby. The altitude was between about 655 and 700 ft (200 m and 213 m) and the nearest part of the trial was about 30 m from the cliff edge. The field had stone walls about 1 m high on three sides and the trial plots were laid parallel to the walls in a NE-SW direction (see plan). One plot of Atem was surrounded by a fence made from a double layer of netlon 80 cm tall. The sheltered area measured 60 m by 2.7 m and was therefore of a shape suitable for combining directly.

Spring barley was sown on 23 April 1981 and the shelter fence was erected on 10 June when the crop was fully tillered and about 20 cm tall. Measurements of wind speed were made inside and outside the shelter on 19 June. Crop height and leaf area were also assessed. Measurements were made on 10 July by Agronomy, Kenton Bar, of plant height, flag leaf area and tiller numbers. Grain yields were obtained at harvest.

Measurements on 19 June

The wind speed was measured using Casella sensitive cup counter anemometers. The cups were 60 cm above the ground and 35 cm above the top of the crop. Measurements were made at two places in the sheltered area, one 9 m from the west end, and one 12 m from the east end. The 'free' wind was measured 5 m upwind of the shelter about mid-way along the north west face of the fence. The wind direction was 350° during the measurements and counts were made over hourly periods to give hourly mean wind speeds at the three places. The weather was dull, with rain at times so that stability effects would be small. The table shows the mean hourly wind speeds measured at the three locations.

Winds in ft/sec

Measurement Period	1		2		3		4	
	Ratio		Ratio		Ratio		Ratio	
Free Wind	4.9		4.1		6.9		9.6	
Sheltered W	3.9	0.8	N/A	-	5.6	0.81	7.9	0.82
Sheltered E	4.2	0.86	3.7	0.9	6.3	0.91	8.8	0.92

These results are for the wind blowing at about 40° to the normal of the north west edge of the shelter screen. This amount of shelter is therefore to be expected for winds between west and north. It is thought that the free wind may have been stronger at the eastern end of the sheltered area, although no measurements were made to confirm this. The shelter screen gives about a 10 to 20% reduction in wind speed. The reduction would be less for south west and north east winds.

Crop Response to Shelter

	19 June		10 July	
	Sheltered	Unsheltered*	Sheltered	Unsheltered
Height (cm)	25-30	20-25	73	60
Flag leaf				
length) (cm)			14.2	15.4
width) (mm)	-	-	10.5	10.0
Tillers/m ²	530	545	417	360
Grain yield (t/ha @ 15% M.C.)			5.53	3.75

* Mean of two plots.

In addition an approximate assessment of leaf area on 19 June showed that the leaf area of the sheltered crop was higher, but the difference was not significant in view of the measurement error involved.

Crop height was increased by shelter. Even a week or so after the shelter was put up, the sheltered crop was a few cm taller. Tiller numbers were similar in mid-June, but tiller death had occurred by the 10 July. The striking feature is that less tiller death had occurred on the sheltered plot. Grain yields were about 50% higher on the sheltered plot. This increase is not accounted for merely by the greater number of ears/m²; the individual ears of the sheltered crop were also heavier.

This yield increase is very large in view of the rather small wind speed reduction. Typical results given by Starr (Review in Agro. Met about shelter) are increases in grain yield of 5-30% in countries such as Denmark and USSR, with the average increase about 10-15%. However, the weather conditions experienced at Boulby in 1981 were such as to make shelter especially effective. The weather conditions are summarised in the graphs. Daily rainfall totals are shown together with occasions when the wind reported at Whitby CG was above 15 kt. The top graph gives the ratio of actual to potential evaporation for low available water content soil in MORECS square 80, and for a crop of spring barley. It is therefore a measure of the reduction in crop growth due to water stress. We see that the crop was growing near the potential rate in May, but the dry weather in June caused a reduction of growth which lasted until early July when heavy showers allowed near potential growth again. June was a windy month, especially around mid-month when speeds in excess of 25 kt (from the west) were reported from Whitby.

It would appear then that the shelter was put up at a critical time. In the weeks after 10 June, the soil dried out and several periods of strong winds occurred. In addition the crop had reached the maximum tiller number and tiller death had begun.

The shelter seems to have reduced tiller death and given heavier ears. It is not known if the heavier ears were due to more grains per ear or higher grain weights.

The crop was sown in the fourth week of April and development was therefore fairly rapid under moist conditions. This may have caused rather poor rooting. A marked change to dry conditions then followed just at the time of peak tiller number when the plants were trying to maintain tillers, grow the ear and the stem simultaneously. These factors may explain the large yield response.

Any comments on this paper should be sent to the author.

Meteorological Office
Harrogate
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SKETCH PLAN OF SHELTER EXPERIMENT.

INGS FARM, BOULBY 1981.

10 m.

NORTH
SEA

WALL 80-130 cm. HIGH

CLIFF
EDGE

213 m.

WALL 80-100 cm. HIGH

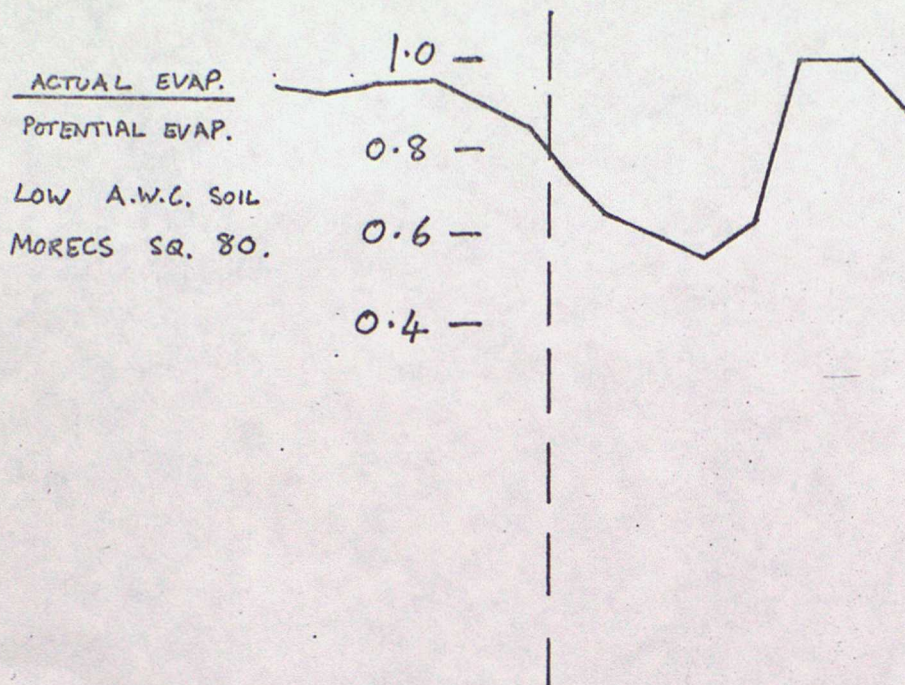
SPRING BARLEY
PLOTS.

SHELTERED
PLOT

WALL 80-100 cm. HIGH

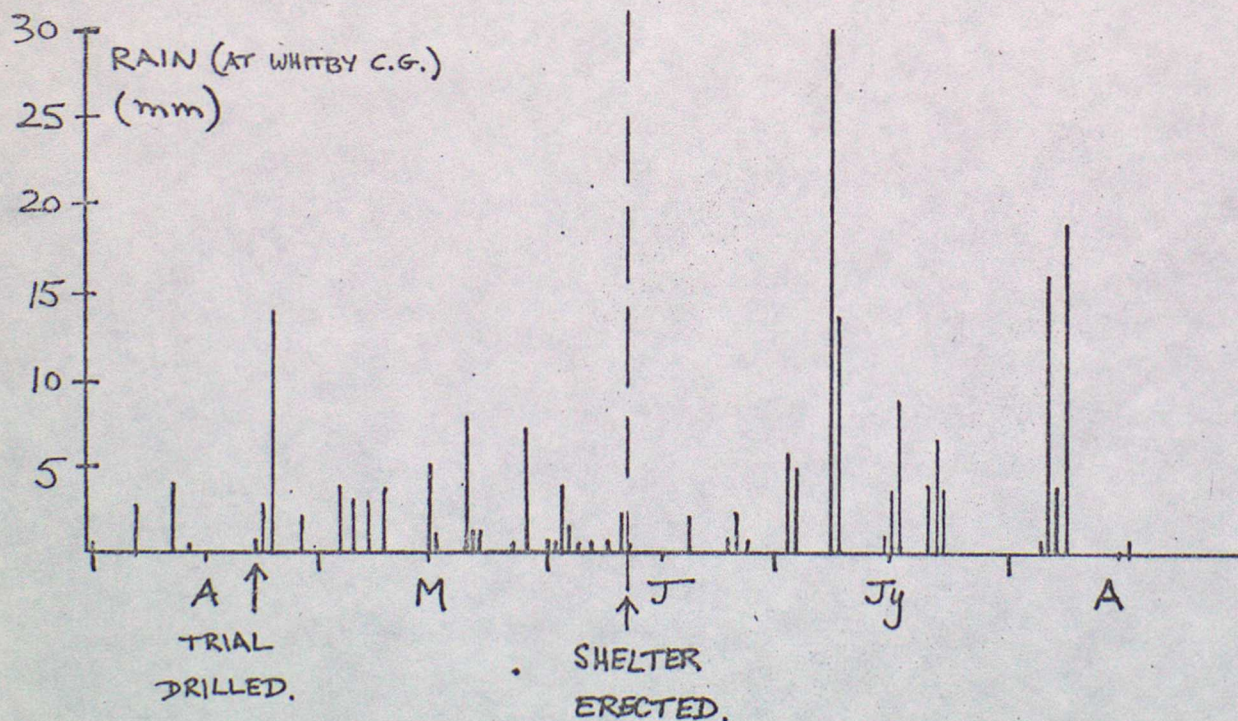
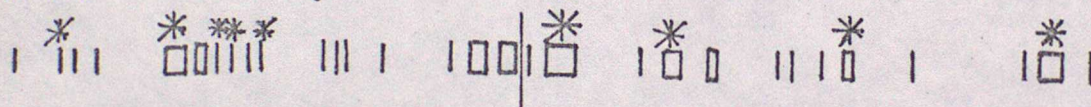
ANEMOMETER POSITIONS: 1. SHELTERED WEST.
ON
19/6/81. 2. FREE WIND.
3. SHELTERED EAST.

THE ARROW GIVES THE WIND DIRECTION ON 19/6/81.



WIND. ABOVE 15 KT. (AT WHITBY C.G.)

* ABOVE 25 KT.



WEATHER CONDITIONS FOR THE TRIAL.